CURRENT LITERATURE

MINOR NOTICES

Trees and shrubs.—Part III of the second volume of this work has been issued,[1] and contains full and lucid descriptions of some 30 species, 25 of which are accompanied by carefully executed full-page illustrations, including detailed drawings of flowers and fruit. Nearly all of the plants considered are native in the South Atlantic and Gulf states, and about one-half of the species treated are new to science. New species are published in the following genera: *Quercus* (1), *Hamamelis* (1), *Crataegus* (3), *Prunus* (6), and *Sambucus* (1). The high standard of excellence, characteristic of the previous parts, is fully maintained in the present issue.—J. M. Greenman.

Flora of Congo.—A second fascicle[2] of the third volume of this work has appeared recently, which records the results of further studies in several families of spermatophytes from the Gramineae to the Compositae. A number of species new to science are included, described, and illustrated in the same excellent manner as in previous fascicles of this flora.—J. M. Greenman.

NOTES FOR STUDENTS

Experiments with maize.—Several years ago Blaringhem[3] published a monograph on his now well known experiments in the production of anomalies in various plants as the result of mutilation. The mutilations forced into development buds which ordinarily remain latent, and the branches produced from these buds frequently possessed characters not recognized as normal features of the plants operated on. In a small percentage of cases the abnormalities thus brought to light were found to be inherited to a greater or less degree, and the conclusion was reached that mutilation is a very general and easy means of provoking mutability and an important factor in the evolution of vegetable forms. Most of his experiments were made with maize, though some apparently corroboratory evidence was derived from barley (*H. distichum* and *H. tetrastichum*) and mustard (*Sinapis alba*). All of the new characters, abnormal or otherwise, which came to light in his experiments with maize

[1] Sargent, Charles Sprague, Trees and shrubs. Illustrations of new or little known ligneous plants, etc. 4to, pp. 117–190. *pls. 151–175.* Boston and New York: Houghton Mifflin Co. 1911. $5.00.

[2] De Wildeman, Émile, Flore du Bas- et du Moyen Congo. Ann. Mus. Congo Belge. Bot. V. **3**:149–316. *pls. 28–49.* 1910. Brussels.

[3] Blaringhem, L., Mutation et traumatismes. Étude sur l'évolution des formes végétales. pp. 248. *pls. 8.* Paris: Felix Alcan. 1908.

were discovered in the descendants of one original plant mutilated by the author in 1902. After that time the pedigrees were kept carefully controlled, either by hand-pollinations or by cultivation in isolated plots.

The reviewer,[4] at about the time this monograph appeared, demonstrated the occurrence of numerous biotypes in hybrid combination in what appeared to be a fairly uniform population of maize, and believes this to be the general situation in this species. JOHANNSEN[5] has pointed out that the reviewer's results favor a different interpretation of BLARINGHEM'S experiences, since the new types which proved to be hereditary may have appeared as the result of segregation of biotypes which were already present in the original plant chosen for mutilation, this segregation being due, not to the mutilation, but to the subsequent method of breeding. GRIFFON[6] has given further support to this interpretation of BLARINGHEM'S results, by showing that similar abnormalities appear when no mutilations have been practiced, and the reviewer has had the same experience. GRIFFON shows that the abnormalities which characterized BLARINGHEM'S forms are strongly dependent upon seasonal conditions for their development, being much more abundant in all cultures in some seasons and less abundant in all in other seasons. He does not agree with BLARINGHEM that with respect to these abnormalities these maize families constitute ever-sporting varieties. It does not follow, however, that abnormalities are not hereditary because they are strongly affected by the environment. HUS and MURDOCK[7] have shown the inheritance of fasciation in a strain of popcorn, the offspring of two fasciated ears giving progenies over 50 per cent of which produced fasciated ears, while an unfasciated ear from the same strain gave only 3 per cent fasciated ears. It will be understood, of course, that the strain from which these ears were selected was complexly hybrid, and that pure-bred derivatives might have shown either approximately 100 per cent fasciated or approximately no fasciation, under favorable conditions. There is evidence that the fasciation is strongly fluctuating, the two ears on a single stem being not infrequently one fasciated and the other normal. The significance of the percentage inheritance is doubtful in complex material of this kind.

The reviewer[8] has presented additional evidence of the hybrid nature of ordinary vigorous maize plants, and their dependence for their vigor upon

---

4 SHULL, G. H., The composition of a field of maize. Report Am. Breeders' Association **4**:296–301. 1908.

5 JOHANNSEN, W., Elemente der exacten Erblichkeitslehre. pp. vi+516. *figs. 31.* Jena: Gustav Fischer. 1909. See p. 451.

6 GRIFFON, E., Observations et recherches expérimentales sur la variation chez le maïs. Bull. Soc. Bot. France **57**:604–615. 1910.

7 HUS, H., and MURDOCK, A. W., Inheritance of fasciation in *Zea Mays*. Plant World **14**:88–96. 1911.

8 SHULL, G. H., Hybridization methods in corn breeding. Amer. Breeders' Mag. **1**:98–107. 1910.

this hybridity. Previous conclusions that F_1 hybrids between self-fertilized strains are on the average equal in yielding capacity, and in certain combinations much superior, to strains cross-bred in the normal manner, have been confirmed; also that reciprocal crosses are essentially equal. In addition it is shown that the yield and quality of the crop are functions of the particular hybrid combination, the results being the same whenever the cross is repeated. The F_1 was found no more variable than the pure self-fertilized parental strains, but the F_2 was considerably more variable, the coefficients of variability in number of rows on the ears in pure biotypes and in their F_1 hybrids being respectively 9.081 per cent and 9.063 per cent, while that of the F_2 was 12.63 per cent. This greater variability in the F_2, also noted by EMERSON[9] in respect to size of seeds and height of stalks, though the latter gives no coefficients, clearly demonstrates the segregation of different grades of such purely quantitative characters. EAST[10] has also presented similar evidence of the segregation of a quantitative character (height of stalk) in the F_2, but he makes no reference to the reviewer's corresponding results published a year earlier. He gives no coefficient of variability for pure strains, but his coefficient for the F_1 was 8.68 per cent, while in the several F_2 families it ranged from 12.02 per cent to 15.75 per cent.

The theory that the increased vigor of cross-bred maize plants is due to a stimulation accompanying heterozygosis requires that crossing within the same biotype or within the same F_1 shall give no advantage over self-fertilization in the same biotype or in the same F_1. The reviewer[11] has reported on a number of such sib-crosses in comparison with corresponding self-fertilizations, the advantage in favor of the crosses being so slight that they can be fairly accounted for by the lack of complete genotypic purity in some of the self-fertilized families. Crosses between sibs in ten self-fertilized families had an average height of 20 dm. and gave an average yield per acre of 30.17 bushels as compared with a height of 19.28 dm. and a yield of 29.04 bushels in the offspring of self-fertilized parents. In the F_2 those families which sprang from sib-crosses in the F_1 had an average height of 23.30 dm. as compared with 23.55 dm. in families produced from self-fertilized parents, and the corresponding yields per acre were 47.46 and 41.77 bushels respectively. These results show that cross-fertilization is of no (or little) advantage except when it brings together unlike hereditary elements. The relations of F_1 and F_2 in regard to height of plants and yield per acre strikingly emphasize the economic importance of using hybridized seed corn. Ten F_1 families had an average height of 25 dm. and produced an average yield of 68.07 bushels,

[9] EMERSON, R. A., The inheritance of sizes and shapes in plants. Amer. Nat. **44**:739–746. 1910.

[10] EAST, E. M., The genotype hypothesis and hybridization. Amer. Nat. **45**: 160–174. *figs. 6.* 1911.

[11] SHULL, G. H., The genotypes of maize. Amer. Nat. **45**:234–252. *fig. 1.* 1911.

while twenty corresponding F_2 families had an average height of 23.42 dm. and gave a yield of only 44.62 bushels per acre.

HAYES and EAST[12] have also shown a similar relation between first and second generation crosses, one such cross giving 105.5 bushels per acre in F_1 and only 51.5 bushels in F_2, another cross giving respectively 117.5 bushels per acre and 98.4 bushels per acre. These authors give a good discussion of the economic bearings of these results and methods of putting them to practical use.

COLLINS[13] has also shown the practical value of hybridization methods in corn growing, reporting on the results of sixteen rather wide crosses, all but two of which gave higher yields than the average of the parents, and all but four exceeding the better parent in yielding capacity. PEARL and SURFACE,[14] while subscribing to the correctness of the genotype idea as applied to maize, are of the opinion that the ordinary ear-to-the-row selection method "in a much cruder and less precise way, really makes use of the same principle" as the reviewer's "pure-line method," and they advocate simply the relaxation of the selection after a few years, by which time the "more strikingly undesirable genotypes will have been automatically eliminated." This view fails to take account of the relatively greater vigor in the F_1 hybrids. EAST,[15] HAYES and EAST,[16] and COLLINS,[17] on the other hand, urge the use of the method of MORROW and GARDNER,[18] as the most practical means of utilizing the greater vigor produced by heterozygosis, and the reviewer believes that the attitude of these authors is justifiable. The method of MORROW and GARDNER is identical with the "pure-line" method, except that highly developed commercial varieties are used in the place of pure self-fertilized strains. The two chosen parental types are grown in alternate rows in an isolated plot, and one variety is detasseled. The seed for the general crop is harvested from the detasseled row, and the process is repeated year after year, using the same parental varieties.

EAST and HAYES[19] have made a most important contribution to knowledge

---

[12] HAYES, H. K., and EAST, E. M., Improvement in corn. Bull. Conn. Agr. Exp. Sta. pp. 21. *pls. 4.* 1911.

[13] COLLINS, G. N., The value of first-generation hybrids in corn. Bull. 191, B.P.I., U.S. Dept. Agr. pp. 45. 1910.

[14] PEARL, R., and SURFACE, F. M., Experiments in breeding sweet corn. Ann. Rep. Maine Agr. Exp. Sta. 1910. pp. 249–307. Bull. 183. *figs. 220–233.*

[15] EAST, E. M., The distinction between development and heredity in inbreeding. Amer. Nat. **43**: 173–181. 1909.

[16] *Op. cit.* [17] *Op. cit.*

[18] MORROW, G. E., and GARDNER, F. D., Field experiments with corn 1892. Bull. 25, Ill. Agr. Exp. Sta. pp. 173–203. 1893.

[19] EAST, E. M., and HAYES, H. K., Inheritance in maize. Bull. Conn. Agr. Exp. Sta. pp. 137. *pls. 25.* 1911.

of the inheritance of unit characters in maize, and have succeeded in clearing up most of the difficulties met by CORRENS and LOCK, and simply by the expedient of applying a strictly *individual* analysis, instead of permitting pollinations from a number of individuals possessing the same characteristics. Only a few of the more striking results can be mentioned. There are two independent genes for yellow endosperm color, giving F_2 ratios 3:1 and 15:1. These are so related as respects dominance that the intensity of the yellow color agrees approximately with the actual number of Y genes present, i.e., the color is most intense in seeds having both genes homozygous, less intense when one gene is homozygous and the other heterozygous, still less intense when both are heterozygous or when either is absent and the other homozygous, etc. This situation results in a distribution of individuals in the form of the probable error curve, and is therefore superficially like that of fluctuating variations, from which it differs however in that the different grades are inherited. In another paper the senior author[20] makes use of these facts in extending Mendelian theory to include variation that is apparently continuous. In the purple aleurone color, EAST and HAYES find no less than four independent genes involved in different varieties, a full purple color requiring the simultaneous presence of both P and C, a full red color the presence of R and C. In the absence of C, both P and R are capable of producing some pigment, giving "particolored" seeds. In addition to these three genes, there was found in a cross between Tom Thumb pop corn and Black Mexican sweet corn, a factor which partially or wholly inhibited the production of the purple aleurone color. This inhibitor or "dominant white" is strictly normal in its hereditary behavior, and its presence in some of LOCK's strains undoubtedly accounts for that investigator's aberrant results. In pericarp colors the authors recognize five independent red-producing genes, R_1 the ordinary red of "red" maize, R_2 the striped red of "calico corn," R_3 a dirty red most abundant at the base of the grains and apparently completely coupled with red silks, R_4 and R_5 a rose red which reaches full development only on exposure to the sunlight. The red cob-color is a simple Mendelian dominant, independent of pericarp color. While starchiness is an endosperm character and shows xenia, the quality of the starch, whether flinty or floury, is a "plant character," and affects all the grains of an ear. Crosses between flint and dent varieties show undoubted segregation with the flint character recessive, but there are probably several genes involved, and the results are obscured by physiological correlation. Furthpr evidence is given that size characters, such as height of stalk, length of ear, and size of grains, segregate normally in the F_2. Several abnormalities are mentioned, dwarfness, striped leaves, split and furrowed cobs, branched ears, and hermaphrodite flowers. With exception of the last, these characters are thought to be inherited in Mendelian fashion, though the

[20] EAST, E. M., A Mendelian interpretation of variation that is apparently continuous. Amer. Nat. **44**:65–82. 1910.

possibility is suggested that fasciation of the ears may be a purely physiological effect of disturbed nutrition.

EMERSON[21] reports the discovery of red aleurone color as a latent character in a cross between Queen's Golden pop corn and Black Mexican sweet corn, though other crosses between these two varieties gave only purple aleurone. Crosses between a tested homozygous red-aleurone strain and White Rice pop corn and Evergreen sweet corn produced F_1's with only purple aleurone cells, thus demonstrating the presence of *P* as a latent character in both of these white varieties. Dark and light yellow endosperm colors were also seen to be latent as a result of a cross between the orange-colored Queen's Golden and the Black Mexican with colorless endosperm.

While not experimental, two papers by ILTIS[22] on abnormalities are worthy of mention. Both of these abnormalities are assumed to have been induced by the traumatic action of *Ustilago Maydis*. In the first the glumes of the female flowers were somewhat enlarged, and in place of the carpel arose a tubular structure 10–20 cm. long, terminated by a long pistil-like thread 20 cm. long. The occurrence of a ligule on this structure served to identify it as a phyllode, and leads the author to the conclusion that the ovary, which afterward forms the seed coat, is homologous with the leaf sheath, and the style with the leaf blade. Within this tube, as a prolongation of the axis, grew an abnormal leafy branch. In the second paper[23] the author describes abnormal inflorescences in which the flowers are paired, each pair consisting of a sessile female or hermaphrodite flower and a stalked male flower. This is an arrangement characteristic of the Andropogoneae, and the author looks upon its appearance in maize as a reversion. On this basis he would rank the Zeae as a subtribe of the Andropogoneae, in support of HACKEL and STAPF, who had adopted this arrangement on other grounds.—GEO. H. SHULL.

Lichen parasites.— TOBLER[24] has studied the relation of two so-called lichen parasites to the lichen host, to the alga on which the lichen grows, and to the substratum to which the lichen is attached. After the manner of thinking commonly followed by European botanists, and often by American as well,

---

[21] EMERSON, R. A., Latent colors in corn. Ann. Rept. Amer. Breeders' Ass. **6:** 233–237. 1910.

[22] ILTIS, H., Ueber eine durch Maisbrand verursachte intracarpellare Prolifikation bei *Zea Mays* L. Sitzungsber. Akad. Wiss. Wien. Math.-naturw. Klasse **119**[1]. pp. 15. *pls. 2.* 1910.

[23] ILTIS, H., Ueber einige bei *Zea Mays* L. beobachtete Atavismen, ihre Verursachung durch den Maisbrand, *Ustilago Maydis* (DC.) Corda über die Stellung der Gattung *Zea* im System. Zeitschr. Abst. Vererb. **5:**38–57. *pls. 2.* 1911.

[24] TOBLER, F., Zur Biologie von Flechten und Flechtenpilzen. I. Ueber die Beziehungen einiger Flechtenparasiten zum Substrat. Jahrb. Wiss. Bot. **49:**389–409. *pl. 3. fig. 1.* 1911.